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Rocky Mountain Research Station

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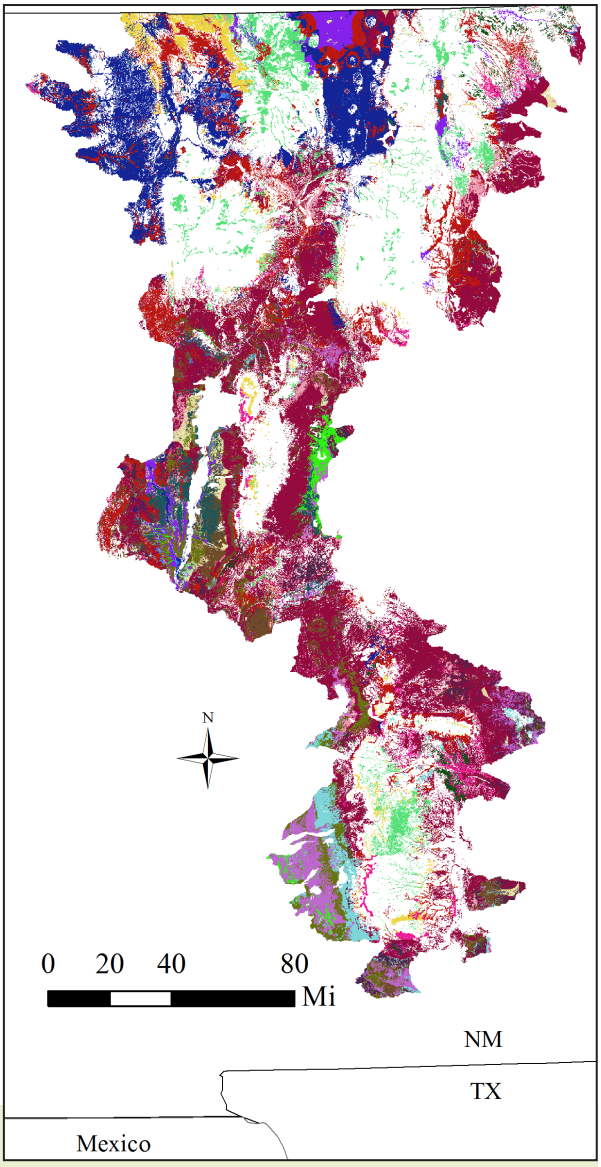
Asking "What-if" Questions: New ST-Sim Tool Helps Managers Forecast Future Rangeland Conditions

Unforeseen Events and Climate Variability

How do land management decisions shape landscapes decades into the future? With the influence of climate change and its associated stressors, it's an increasingly thorny question. According to Paulette Ford, a research ecologist with the Rocky Mountain Research Station in Albuquerque, New Mexico, "Land managers were coming to me and saying, 'The rain's coming too late in the season,' or 'We've got these weird fire cycles.' What they're talking about is unprecedented events and climate variability."

To help address these concerns, Rocky Mountain Research Station scientists partnered with a company called Apex Resource Management Solutions (commonly known as "Apex") to use a software-based ecological simulation tool called ST-Sim, which is short for state-and-transition simulation model. ST-Sim allows managers to ask landscape-wide "what-if" questions based on different management regimes and land treatments while estimating interactions with expected climate changes. As Ford explains: "With this tool, we're able to provide land managers with worst-case and best-case scenarios under different conditions. One example of where this can be used is the Ogallala Aquifer, which underlies parts of eight states. It's being drawn down and there are concerns about what will grow there."

Using computer-aided modeling, land management teams can use ST-Sim to document or justify management actions in forthcoming forest plans and NEPA documentation.



ST-Sim simulation models of New Mexico's Rocky Mountains region were created to help land managers prioritize restoration locations based on suitable vegetation types. On this image, each color represents a potential vegetation type (PVT) that signifies a certain physical and biological environment that produces a distinctive kind of vegetation. The color-coded areas represent an area of just under 10 million acres and encompass 18 different PVTs. The most prominent PVT on the landscape is Shortgrass Steppe – Juniper Potential, represented in burgundy, with over 3 million acres (image by M. Reeves, USDA Forest Service).

Asking "What-if" Questions

Although ST-Sim has been available since 2013, it was recently deployed in the Forest Service's Southwest Region to predict the ecological response of rangelands to livestock grazing across numerous vegetation types. Net annual primary production and ecological response to herbivory were calibrated for 19 potential vegetation types covering nearly 10 million acres. A new paper in Rangelands describes this project as "A Tool for Projecting Rangeland Vegetation Response to Management and Climate." Using ST-Sim, scientists projected a variety of conditions, including vegetative state transitions, net primary production, drought likelihood, and forage use and grazing targets. One prediction was that, in grazing areas, drier conditions may quickly cause perennial grass cover to be replaced by weedy annual and sparse grasses. Another prediction was that forage grazing targets for some ecological systems would drop significantly below 35 percent of historic annual production.

Leonardo Frid, an ecologist for Apex who specializes in modeling, says ST-Sim is a package for an Apex-designed framework called SyncroSim, which manages "big data" scenario inputs and outputs for any kind of simulation model. "We're trying to quantify uncertainties and communicate their significance to natural resource managers," Frid says, with applications that include various land cover types and managing for species of interest.

Generating the Best Available Data

To find out more about how to download ST-Sim or get links to documentation and video tutorials, visit the Rocky Mountain Research Station website at https://www.fs.usda.gov/rmrs/projects/grasslands-rangelands-and-beyond-predicting-landscape-conditions-st-sim. According to Matt Reeves, a research ecologist with the Rocky Mountain Research Station in Missoula, Montana, "Managers have to invest a little bit of time into figuring out how to use the tool, but it can generate some of the most valuable information that's available right now. There are video tutorials available and we are happy to work with folks."

MANAGEMENT IMPLICATIONS

- Based on ST-Sim models, increased drought in the Southwest Region may lead to shrub encroachment and transitions between vegetative states, particularly without grazing adjustments.
- ST-Sim can be used to prioritize sites and vegetation types that are candidates for restoration or resilience-building management regimes.
- This ST-Sim software can be used on any National Forest System unit and beyond. Download links, video tutorials, and other resources at https://www.fs.usda.gov/rmrs/projects/grasslands-rangelands-and-beyond-predicting-landscape-conditions-st-sim.

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ST-Sim projected many areas where grasslands may transition to juniper-dominated ecosystems (photo by J. Triepke, USDA Forest Service).

FURTHER READING

Ford, P.L.; Reeves, M.C.; Frid, L. 2019. A tool for projecting rangeland vegetation response to management and climate. Rangelands. 41(1): 49-60. https://www.fs.usda.gov/rmrs/publications/tool-projecting-rangeland-vegetation-response-management-and-climate.